

REMARKS

This amendment responds to the office action mailed June 6, 2003. In the office action the Examiner:

- ☐ rejected claims 1-4 and 59 under 35 U.S.C. 103(a) as being unpatentable over Liu (Applied Physics Letters vol. 75) in view of EP 1,065,728;
- ☐ rejected claims 5-12 also under 35 U.S.C. 103(a) as being unpatentable over Liu in view of EP 1,065,728;
- ☐ rejected claims 13, 14 and 20 under 35 U.S.C. 103(a) as being unpatentable over Liu in view of EP 1,065,728 and Pogossian (1999 Optical Society of America);
- ☐ rejected claims 15-19, 26-45, 50-55, and 60-75 under 35 U.S.C. 103(a) as being unpatentable over Liu in view of Pogossian; and
- ☐ rejected claims 21-25, 46-49 and 56-58 under 35 U.S.C. 103(a) as being unpatentable over Liu in view of EP 1,065,728 and Pogossian

In this response claims 19-20, 44-45, 50-52, 61 and 62 have been amended, claims 56-58 have been cancelled, and new claims 76-78 are presented. The specification has been revised to correct typographic errors. Also, a drawing page is submitted to replace the drawing page for FIG. 5(a)-(e), which neglected a reference numeral 611. After entry of this amendment, the pending claims are claims 1-55 and 59-78.

The rejection of claim 1 over Liu in view of EP 1,065,728 is respectfully traversed. Claim 1 as originally submitted recites a method for forming a waveguide structure, comprising the steps of forming a first graded layer and forming a second graded layer above the first graded layer. The first graded layer includes silicon, germanium and a lattice constant adjusting material, wherein concentrations of germanium and the lattice constant adjusting material increase with height. The second graded layer includes silicon, germanium and the lattice constant adjusting material, wherein concentrations of germanium and the lattice constant adjusting material decrease with height. Although Liu discloses forming a graded SiGe layer with the Ge concentration linearly graded from 0% to 50%, neither Liu nor EP 1,065,728 discloses or suggests forming the second graded layer having decreasing Ge concentration above the graded SiGe layer. In Liu, the formation of the graded SiGe layer with increasing Ge concentration is followed by the formation of a constant SiGe buffer layer

(p. 1587, end of first paragraph). There is no disclosure or suggestion of forming a layer with decreasing Ge concentration afterwards. Therefore, claim 1 is patentable over Liu in view of EP 1,065,728.

Claims 2-18, amended claims 19-20, and claims 21-29 depend from claim 1 and include further limitations in addition to the limitations in claim 1. Therefore, claims 2-18, amended claims 19-20, and claims 21-29 are patentable for at least the same reasons claim 1 is patentable.

The rejection of independent claim 30 over Liu in view of Pogossian is also respectfully traversed. Claim 30 as originally submitted recites a method of forming a waveguide structure by providing a substrate with an etched pattern, by forming a uniform layer to fill the etched pattern, and by planarizing the uniform layer, wherein the uniform layer contains silicon, germanium and a lattice constant adjusting material in substantially uniform concentrations. These claimed features are not found in Liu and Pogossian. Pogossian forms a SiGe layer in an etched pattern but the SiGe layer in Pogossian does not fill the etched pattern. Pogossian also does not teach forming a waveguide structure by planarizing a uniform layer after it is formed to fill an etched pattern. Also, since Liu does not discuss at all forming SiGe layer in an etched feature, these two references cannot be properly combined to suggest the method in claim 30. The Examiner's requirement for unexpected results is improper here because the method of forming the waveguide structure as recited in claim 30 is clearly different from those disclosed in Pogossian. The waveguide formed using the method of claim 30 and those formed using the methods in Pogossian have substantially different geometries which suggest that these waveguides should have substantially different properties. This is evidenced by Pogossian, which illustrates in Fig. 4 and in associated texts the impact of even a slight change in layer geometries on the confinement of the light in waveguide structures. Therefore, since Liu does not disclose or suggest forming a SiGe layer in an etched feature and since Pogossian does not disclose or suggest filling an etched feature with a SiGe layer and planarizing the same afterwards, claim 30 is patentable over Liu in view of Pogossian.

Claims 31-43, amended claims 44-45, and claims 46-49 depend from claim 30 and include further limitations in addition to the limitations in claim 30. Therefore, claims 31-43, amended claims 44-45, and claims 46-49 are patentable for at least the same reasons claim 30 is patentable.

Independent claim 50 as amended recites a method of forming a waveguide structure by providing a substrate having a first portion covered by a layer of material different from

that of the substrate and by selectively depositing a first graded SiGeC layer on a second portion of the substrate not covered by the layer of material. The method further comprises selectively depositing a uniform SiGeC layer over the first graded layer and selectively depositing a second graded SiGeC layer over the uniform layer, wherein germanium and carbon concentrations in the first graded layer increase with height while germanium and carbon concentrations in the second graded layer decrease with height. The claimed features in amended claim 50 are not disclosed or suggested in Liu and Pogossian. Firstly, neither Liu nor Pogossian discloses or suggests forming the second graded SiGeC layer with decreasing germanium and carbon concentrations above a uniform SiGeC layer, which is above the first graded SiGeC layer. Furthermore, neither Liu nor Pogossian discloses or suggests selectively depositing a graded SiGeC layer over a substrate, a portion of which is covered by a layer of material, so that the graded SiGeC layer is only formed over another portion of the substrate not covered by the layer of material. Therefore, claim 50 as amended is patentable over Liu in view of Pogossian.

Claims 51-55 depend from claim 50 and include further limitations in addition to the limitations in claim 50. Therefore, claims 51-55 are patentable for at least the same reasons claim 50 is patentable.

The arguments regarding claim 1 are applicable to independent claim 59. Also, claim 59 includes the further limitation of forming a uniform layer over the first graded layer and before forming the second graded layer. Therefore, claim 59 is believed to be patentable.

The arguments regarding claim 30 are applicable to independent claim 60. Therefore, claim 60 is believed to be patentable.

The arguments regarding claim 50 as amended are applicable to independent claim 61 as amended. Therefore, claim 61 is believed to be patentable.

Independent claim 62 as amended recites a waveguide structure comprising a first graded layer on a substrate and a second graded layer above the first graded layer. The first and the second graded layers include silicon, an index of refraction adjusting material and a lattice constant adjusting material, wherein concentrations of the index of refraction adjusting material and the lattice constant adjusting material increase with height in the first graded layer and decrease with height in the second graded layer. The waveguide structure of amended claim 62 is not found in Liu, Pogossian, or their combinations because neither Liu nor Pogossian discloses or suggests a waveguide structure having a second graded layer above a first graded layer. Therefore, claim 62 as amended is patentable over Liu in view of Pogossian.

Claims 63-69 depend from amended claim 62 and include further limitations in addition to the limitations in amended claim 62. Therefore, claims 63-69 are patentable for at least the same reasons claim 62 is patentable.

Independent claim 70 recites a waveguide structure comprising a substrate having an etched pattern and a uniform layer filling the etched pattern, wherein the uniform layer includes silicon, germanium and a lattice constant adjusting material in substantially uniform concentrations. The waveguide structure of amended claim 70 is not found in Liu, Pogossian or their combinations because neither Liu nor Pogossian discloses or suggests a waveguide structure having a uniform SiGe layer filling an etched pattern in a substrate. Pogossian discloses a waveguide structure having a SiGe layer in an etched pattern but the SiGe layer in Pogossian does not fill the etched pattern. Also, since Liu does not discuss at all a SiGe layer in an etched feature, these two references cannot be properly combined to suggest the method in claim 70. The Examiner's requirement for unexpected results is improper here because the waveguide structure of claim 70 and those disclosed in Pogossian have substantially different geometries which suggest that they also have substantially different properties. This is even evidenced by Pogossian, which illustrates in Fig. 4 and in associated texts the impact of even a slight change in layer geometries on the confinement of the light in waveguide structures. Therefore, since Liu does not disclose or suggest forming a SiGeC layer in an etched feature and since Pogossian does not disclose or suggest filling an etched feature with a SiGeC layer and planarizing the same afterwards, claim 70 is patentable over Liu in view of Pogossian.

Claims 71-75 depend from claim 70 and include further limitations in addition to the limitations in claim 70. Therefore claims 71-75 are patentable for at least the same reasons claim 70 is patentable.

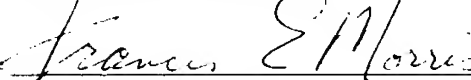
New independent claim 76 recites a waveguide structure comprising a silicon substrate having an etched trench, a first graded SiGeC layer covering sidewall and bottom surfaces in the trench, a uniform SiGeC layer formed in the trench over the first graded SiGeC layer, and a second graded SiGeC layer covering the first graded layer and the uniform layer. Support for new claim 76 can be found in FIG. 9 and the part of the specification corresponding to FIG. 9. Claim 76 is believed to be patentable over the cited references because none of the cited references discloses a waveguide structure formed in a silicon trench that has a first graded layer covering sidewall and bottom surfaces of the trench, a uniform layer in the trench and over the first graded layer, and a second graded layer over the uniform layer. New claims 77-78 as amended depend from new claim 76 and include

further limitations in addition to the limitations in claim 76. Therefore, new claims 77-78 are patentable for at least the same reasons new claim 76 is patentable.

In light of the above amendments and remarks, the Applicants respectfully request that the Examiner reconsider this application with a view towards allowance. The Examiner is invited to call the undersigned attorney at (650) 847-7777 if a telephone call could help resolve any remaining issues.

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Respectfully submitted,



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